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CA 2133100 C 2004/01/20

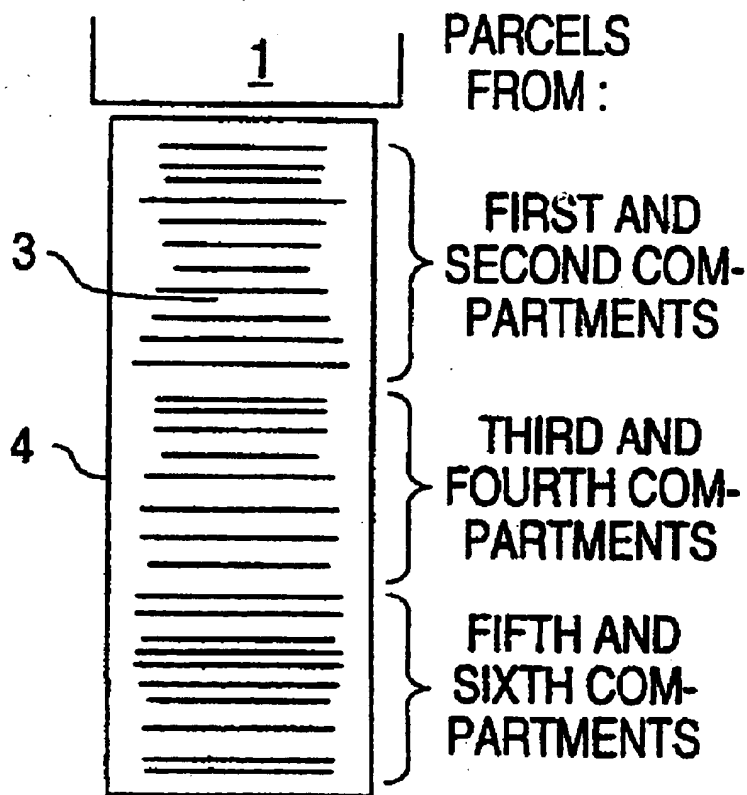
(11)(21) **2 133 100**

(12) **BREVET CANADIEN
CANADIAN PATENT**
(13) **C**

(86) Date de dépôt PCT/PCT Filing Date: 1994/01/25
(87) Date publication PCT/PCT Publication Date: 1994/08/04
(45) Date de délivrance/Issue Date: 2004/01/20
(85) Entrée phase nationale/National Entry: 1994/09/27
(86) N° demande PCT/PCT Application No.: EP 1994/000197
(87) N° publication PCT/PCT Publication No.: 1994/016829
(30) Priorité/Priority: 1993/01/28 (P 43 02 231) DE

(51) Cl.Int.⁵/Int.Cl.⁵ B07C 3/06
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(54) Titre : METHODE DE SEQUENCEMENT D'ARTICLES DANS LES SYSTEMES DE TRI DU COURRIER
(54) Title: A PROCEDURE FOR SEQUENCING ITEMS IN LETTER SORTING SYSTEMS



(57) Abrégé/Abstract

In the procedure according to the present invention for sequencing items of mail in a letter-sorting system, with rows of pigeonholes, in order to sort the items into the pigeonholes, a sorting plan in which overfilling the pigeonholes is avoided is used, so that the pigeonholes are not emptied during a sorting pass and so that, in each instance, after the conclusion of a sorting pass, the items are reloaded, in the correct sequence, from the pigeonholes into a conveyor system that is arranged opposite the pigeonholes or into containers.

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**A Procedure for Sequencing Items of Mail
in a Mail-Sorting System**

Abstract

In the procedure according to the present invention for sequencing items of mail in a letter-sorting system, with rows of pigeonholes, in order to sort the items into the pigeonholes, a sorting plan in which overfilling the pigeonholes is avoided is used, so that the pigeonholes are not emptied during a sorting pass and so that, in each instance, after the conclusion of a sorting pass, the items are reloaded, in the correct sequence, from the pigeonholes into a conveyor system that is arranged opposite the pigeonholes or into containers.

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A Procedure for Sequencing Items in Letter Sorting Systems

The present invention relates to a procedure for the improved sequencing of items in letter-sorting systems.

Mail, in particular letters, are sorted in letter-sorting systems, possibly after previous pre-sorting procedures, and then deposited in a number of pigeonholes. When this is done, the degree of refinement achieved in the distribution during each sorting pass is determined by the number of pigeonholes amongst which the mail is to be distributed. Frequently, however, it is neither desired nor possible, for practical reasons, to provide a dedicated pigeonhole for each small class within a sorting procedure. For example, a dedicated pigeonhole will not be required for each recipient if the mail is to be sorted according to the sequence of a distribution in the course of a mail walk. Rather, the mail will be sorted into a specific number of pigeonholes, in the same sequence in which it is to be subsequently delivered by the mailman during his walk. Within each pigeonhole, the mail is arranged according to the prescribed sequence, so that given an appropriate arrangement of the pigeonholes, all of the mail is arranged in accordance with the prescribed sequence. In order to be able to manage with sorting systems that incorporate a relatively small number of pigeonholes, the mail is sorted several times, and under some circumstances, indirectly, as is described, for example, in the Proceedings USPS Advanced Technology Conference, Washington, DC, 2.12.1992, pp. 1061-1074.

Already known are mail sorting systems in which the pigeonholes are arranged opposite the (material) inputs, so that after each sorting pass, that is followed by a subsequent sorting pass, the mail can be introduced again very rapidly into an input module.

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During manual reloading, the mail is in each instance reloaded into the container by handfuls from the pigeonhole, the container being set up in a mobile frame, opposite the pigeon holes. When this is done, it is customary that the containers are of a greater capacity than the pigeonholes, which are emptied several times during each sorting pass in order to be reloaded. A requirement for sequencing using the procedure described above is that the sequence of the items be strictly maintained after the first and for all subsequent sorting passes, and during the reloading (sequence integrity), to which end it is essential that after each sorting pass, the containers with the mobile frames or additional movement aids be returned for input or else sorted into groups that are suitable for further processing after the final sorting pass. Disadvantages of the prior art are, in particular, the fact that at least two operators are needed for inputting and for emptying the pigeonholes; and that restacking or intermediate stacking of the mail in the containers requires more space and entails the risk that sequence integrity may be jeopardized because the stacks can topple over very easily in the containers if the container is only partially filled; this disrupts the sequence that has been established; the stacks can also be loaded into the wrong containers accidentally; or the sequence of the containers may become confused.

It is the task of the present invention to describe a procedure that avoids the disadvantages found in the prior art and permits simple, rapid, and reliable sequencing of mail whilst retaining sequence integrity. Compared to the prior art, the procedure according to the present invention entails the advantages that, for all practical purposes, there are no partially filled containers, the risk of sequence integrity being disrupted is avoided, and less space is required.

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Accordingly, in a broad aspect of the invention, there is provided a method for sorting items of mail into a walk sequence in a plurality of sorting passes in letter sorting systems with rows of pigeonholes, the method comprising the steps of: sorting the items into the pigeonholes according to a sorting plan, according to which all, or nearly all, of the pigeonholes are filled at most to its maximum capacity during a sorting pass and, in the event that a pigeonhole is full, an overflow pigeonhole will be assigned to it, and subsequent sorting will be done into the overflow pigeonhole; unloading, after the conclusion of a sorting pass, the items from the pigeonholes in a proper sequence into a delivery device that is arranged opposite the pigeonholes.

The present invention proceeds from the idea that the pigeonholes are not emptied during a sorting pass in a sequencing procedure; a sorting plan is used in which, as far as possible, no pigeonhole is filled or overflows, and after the conclusion of the sorting pass, the contents of the pigeonholes are reloaded, in proper sequence, directly into a delivery device that serves the input module, or are reloaded into containers and then passed, in the proper sequence, to the input module, or to further processing.

The present invention will be described in greater detail below on the basis of the drawings appended hereto. These drawings show the following:

Figure 1: A letter sorting system for carrying out the procedure according to the present invention;

Figure 2: The association of the contents of a container to the individual pigeonholes after unloading the

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pigeonholes, for the event that two pigeonholes are provided for each destination (direction);

Figure 3: The sequence of sequenced items in the pigeonholes, at 800 stops;

5 Figure 4: The sequence of the sequenced items in the containers, at 800 stops.

Figure 1 is a diagrammatic representation of a letter sorting system for carrying out the procedure according to the present invention, in which a number of
10 pigeonholes 1 are arranged opposite a delivery device 2, with which the items 3 have been loaded into the transport container 4,

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are moved to the input module 5. A reloading bridge 6, as is known, for example, from DE 42 36 507, that is arranged between the pigeonholes and the delivery device, and which can move along the row of pigeonholes 1, is used to provide for the rapid and reliable reloading of the items from the pigeonholes 1 into the containers 4, and the subsequent transportation to the delivery system 2.

For purposes of simplification, the present invention will be described using the example of sequencing in two sorting passes, for it will be clear to the practitioner skilled in the art how the procedure can be generalized to a case involving more than two sorting passes. As is customary, during the first sorting pass, sorting is carried out according to the least significant place (least significant digit, LSD). When this is done, the sorting plan is such that, as far as possible, the filling of the individual containers is avoided. Such optimization is possible, since experience indicates that mail for specific destinations only varies about a statistical mean value by a limited amount; this can be determined by measurements and used as the basis for the sorting plan. According to the present invention, no pigeonhole is emptied during the first sorting pass. After the conclusion of the sorting pass, the items are reloaded by the reloading bridge 6 directly from the pigeonhole 1 into the containers 4, when the pigeonholes that follow each other in sequence are emptied one after the other into a container, until the container is full. In each instance, the reloading bridge forms a continuous sliding path between a pigeonhole and the delivery device that is opposite. To a very large extent, the occurrence of partially filled containers is avoided in this way, and this minimizes any possible problems connected with stacks of mail toppling over within the containers. The containers that have been so filled are arranged one behind the other in the delivery device 2. It is preferred that a conveyor system 2 be provided in order to do this, and the width of this conveyor should be approximately the same as the width of the containers that are used. Thus, the pigeonholes are emptied into the containers and the containers

are arranged within the delivery device or on the conveyor belt 2 in sequence. If, for example, the LSD contains the elements a, b, c, d, e, f, g, h, i, k, in ascending order, then the pigeonholes will be emptied in the sequence k, i, h, g, f, e, d, c, b, a, as is shown in Figure 1, and the items are so arranged in each container that the highest elements of the LSD are stacked at the end of the container, with the lowest at the front. The containers are placed on the conveyor belt in such a way that the end of a container that has been newly placed on the conveyor is adjacent to the front of a container that is already on the container. It is preferred that such an arrangement be achieved in that the reloading bridge incorporates a funnel-shaped asymmetrical extension. This obligatory arrangement and delivery of the containers avoids the disruption of the sequence of the containers and thus of sequence integrity. In a letter sorting system as shown in Figure 1, this type of reloading procedure is effected as follows: the reloading bridge 6 is moved by an operator along the series of pigeon holes in such a way that the sequence k, i, h, g, f, e, d, c, b, a of the pigeon holes is passed, i.e., in Figure 1, from right to left. The operator goes behind the bridge 6, and with his right hand raises the separator blade that is normally used in the pigeonholes in order to stabilize the items, supports the stacked items with his left hand, returns the separator blade to its starting position, and then uses both hands to slide the items into the container that is located on the bridge. In the event that the stack of items will not fit exactly into the space that is available within the container, initially only part of the stack is removed from the pigeonhole, and the remainder is once again secured by the separator blade. The filled container is pivoted on the conveyor which, in Figure 1, corresponds to a turning movement to the left by the operator, so that the last items placed in the container are at the side of the container that is remote from the input module. Next, the operator

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takes an empty container and begins to fill this with the remaining items. It is preferred that the conveyor 2 end before the input module, so that the container can simply be slid into or unloaded into the module.

In the second sorting pass, the items are sorted according to the most significant digit (MSD) and placed in the pigeon holes, when a suitably optimized sorting plan ensures that in the second sorting pass, too, the pigeon holes are not, as far as possible, overfilled. After the conclusion of the sorting pass the pigeon-holes are emptied into the containers in the same way as in sorting pass number 1. The containers are removed from the conveyor belt in sequence, reloaded into the appropriate carts, and passed on for further processing.

Naturally, the procedure according to the present invention is not linked immutably to the use of containers. Rather, it is also possible to remove the items from the pigeonholes 1 immediately after the first sorting pass, and shift them onto the conveyor belt 2 by way of a reloading bridge, so that the items are then passed to the input module in the correct sequence. All that is required in order to do this is to ensure that the stacks of items lie closely against each other, so that the stacks do not topple over. This can be achieved quite simply, e.g., by appropriately controlled movement of the conveyor belt 2, by which the items 3 that are on the conveyor belt 2 are moved to the reloading bridge 6 as the particular pair of stacks is being emptied.

The dimensioning of a sorting system with 200 pigeonholes, each with a stack capacity of 350 items, for the case when there are 2000 or 1500 items per mailman, will be described below.

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Given a system with 200 pigeonholes for 350 charges, it is possible to process a maximum of 70,000 items in a sequencing run. In order to have reserves for items of different thicknesses and unequally filled pigeonholes, the system is run at only 70 per cent capacity, i.e., for approximately 50,000 items. It is assumed that each mailman has to service 800 stops. This means that, for example, given a number of 2000 items per mailman for each sequencing run, there will be 200 . 200 stops available (see, for example, Proceedings USPS Advanced Technology Conference, Washington, 2.12.1992, pp. 1061-1074). The following table presents an overview of the different number of items per mailman cited above.

Example	A	B
Items/mailman *	2000	1500
Deliver stops/mailman *	800	800
Number of mailmen per sequencing run	25	33
Total number of delivery stops	20,000	26,400
Available (200 . 200)	40,000	40,000
* = average values		

The table shows that in Example A, during the first sorting run, two pigeonholes per destination (direction) can be provided; in Example B, two pigeonholes can be provided for each second destination. In such a case, initially

the first pigeonhole is filled, and then a switch is made to the second, adjacent pigeonhole. The sequencing procedure for Example A will be described in greater detail below. In the first sorting run, the following pigeonholes will be passed:

1 + 2	DSN 001, 101, 201, 301, 401, 501, 601, 701
3 + 4	DSN 002, 102, 202, 302, 402, 502, 602, 702
5 + 6	DSN 003, 103, 203, 303, 403, 503, 603, 703
and so on	
199 + 200	DSN 100, 200, 300, 400, 500, 600, 700, 800

When this is done, the mailman's stops are assigned a DSN (delivery sequence number).

As has been discussed above, one starts with reloading the items into the containers from the back, so that the highest values of the DSN are stacked at the end of the container, with the lowest being at the front. Figure 2 shows--for Example A--the contents 3 of a container 4 after unloading the pigeonholes 1 to 6, the pigeonhole number 1 bearing the reference number 8. The contents of pigeonhole 5 and 6 are stacked at the end of the container, whereas the contents of pigeonholes 1 and 2 are at the front. For this reason, if the mail is removed from the container after the first sorting pass, the contents of pigeonhole 1 will be the first to be distributed in sorting pass 2, and after sorting pass 2, they will be at the front end of the particular pigeonhole into which the items having to be been stacked.

In the second sorting pass, each mailman in Example A has eight pigeonholes into which the items have been sorted, as is shown in Figure 3. According to this, the items with the DSN's 1 to 100 will be in a first pigeonhole, those with DSN's 101-200

will be in a second pigeonhole, and so on, the items with DSN 701-800 will be in an eighth pigeonhole. Mailmen who have to deliver only 700 or 600 DSN require correspondingly fewer pigeonholes; if there are more than 800 DSN, then correspondingly more pigeonholes will be needed. In order to arrive at a correctly sequenced arrangement of the items in containers, the reloading from the pigeonholes in Figure 3 into the containers will be completed from right to left. The sequence of the items that results in the containers as a result of this is shown by way of example in Figure 4. Once again, it is shown that the items with the lowest DSN are in the front parts of the containers, and those with the higher DSN are stacked in the rear parts.

In the procedure according to the present invention, an optimized sorting plan ensures that the probability that the pigeonholes will be overfilled is very low. In the unlikely event that an overflow does occur, two or three overflow pigeonholes, that can be assigned as required, can be provided for each row of pigeonholes, and these can be inserted into the sequence by an appropriate signal when the pigeonholes are being emptied. In the event that a pigeonhole is filled, one of the unassigned overflow pigeonholes will be assigned to this destination (direction), and subsequent items will be stacked in this. When the pigeonholes are emptied, the operator will be warned, for example, by a flashing light, that the overflow pigeonhole is to be emptied and cleared. The overflow pigeonhole that is to be cleared will be indicated in the pigeonhole display. As a result, there will be only a few exceptions in the sequence in which the pigeonholes are emptied, whereas, generally speaking, no changes will be needed during the course of the procedure.

In order to provide for particularly simple and precise emptying of the pigeonholes, it is preferred that the pigeonholes be those described in DE 38 23 644, which have movable bottoms. Such a container permits direct stacking of the items from the pigeonhole, without the items have to be raised

or lifted over the edge of the container by the operator. Furthermore, the use of this container makes it possible to slide the items from the container directly into the input tray of the input module. Because of the fact that the items are aligned on the edge of the stack within the container, it is not necessary to realign the items.

In the above, for purposes of simplification, a sorting system with only one row of pigeonholes has been used as a basis. However, multi-layered arrangements of pigeonholes are customary. Accordingly, in the procedure according to the present invention, a reloading bridge 6 that can be adjusted for height is used. In this, the sliding surface of the reloading bridge can be raised or lowered to the level of the bottoms of the pigeonholes. Thus, each row of pigeonholes (strand) is arranged opposite a conveyor device or conveyor belt. In order to move from the different heights of the conveyor belts to the height of the input device of the input module, a movable height-equalizing bridge is used.

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CLAIMS:

1. A method for sorting items of mail into a walk sequence in a plurality of sorting passes in letter sorting systems with rows of pigeonholes, the method comprising the
5 steps of:

sorting the items into the pigeonholes according to a sorting plan, according to which substantially every pigeonhole is filled at most to a maximum capacity during a sorting pass;

- 10 in the event that a pigeonhole is full, assigning an overflow pigeonhole to the full pigeonhole, and subsequently sorting into the overflow pigeonhole; and

unloading, after the conclusion of a sorting pass, the items from the pigeonholes in a proper sequence into a
15 delivery device that is arranged opposite the pigeonholes.

2. The method as defined in claim 1, further comprising moving a reloading bridge along the rows of pigeonholes for reloading into the delivery device or a container.

- 20 3. The method as defined in claim 2, further comprising filling the containers to their maximum capacity during the reloading process.

4. The method as defined in any one of claims 1 to 3, further comprising visibly signalling an operator in the
25 event that the sorting is performed into the overflow pigeonhole.

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5. The method as defined in any one of claims 1 to 4, further comprising assigning more than one pigeonhole to a destination.

6. The method as defined in any one of claims 2 to 5,
5 further comprising moving the containers after reloading onto a conveyor belt for further processing.

7. The method as defined in any one of claims 2 to 6, wherein the container comprises a movable compartment bottom, the container being for direct stacking of the
10 items.

8. The method as defined in any one of claims 2 to 7, wherein the pigeonholes are in a multi-layered arrangement and reloading is carried out onto conveyor belts that are arranged one above the other.

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FIG. 1

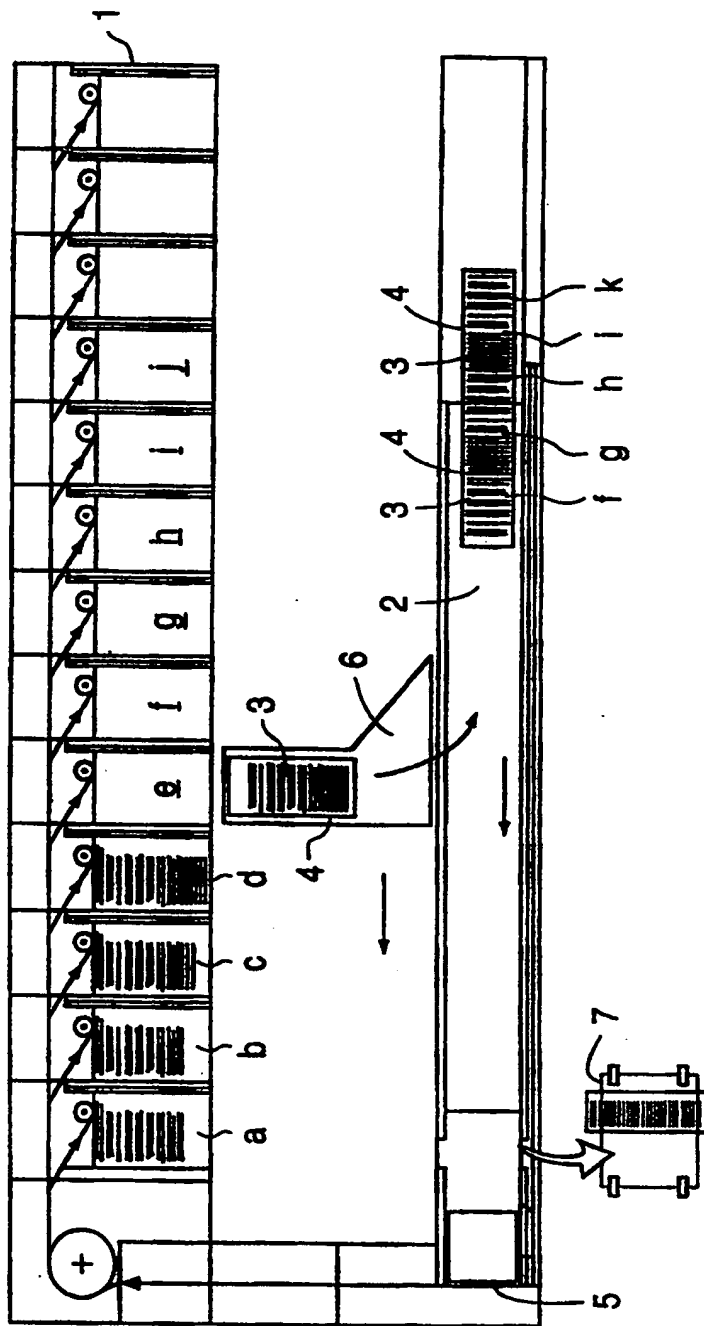
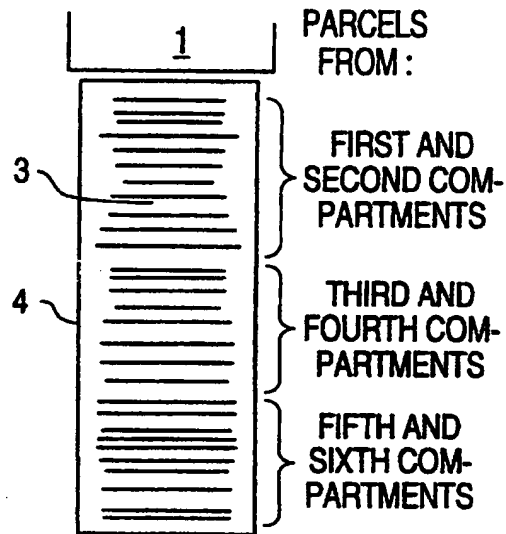
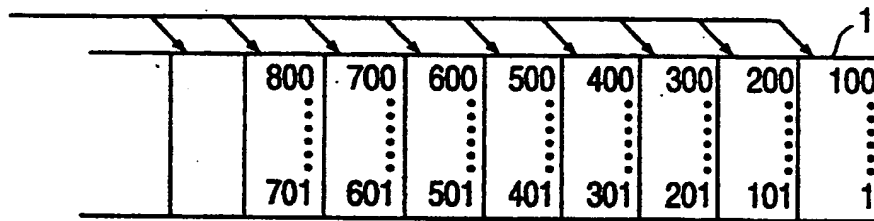


FIG. 2**FIG. 3****FIG. 4**